A Lecture
ON
THE PSYCHOLOGY OF ANIMALS SWALLOWED ALIVE.

DELIVERED AT THE ROYAL COLLEGE OF SURGEONS OF ENGLAND ON JUNE 5TH
BY

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Many discoveries and observations made by naturalists are of little interest to the public, but animal psychology and vagaries of the human mind are interesting to all.

WHEN sitting in quiet contemplation digesting after dinner, with beneficent microbes hard at work within me, I sometimes wonder if animals who swallow their prey alive are worried by the acrobatic efforts of victims trying to escape.

The same idea must have occurred to many boys after reading the curious experience of Jonah, swallowed alive by a big fish and subsequently vomited none the worse for his adventure. In Matthew's Gospel the creature that swallowed Jonah is called a whale. Matthew may have been a good evangelist but not a naturalist. This is not surprising, for he was a customs officer under Herod the Tetrarch. There is a tradition that Jonah was the son of the widow of Zarephath; Elijah restored him to life, and delivered him to his mother, saying, See, thy son liveth.

The story of Jonah and the whale has been the source of many quips. There is a miserere in the stalls of Ripon Cathedral representing the prophet in the act of being swallowed by a whale—the mouth of the beast is well furnished with teeth—and another representing him emerging from the mouth of the whale (Fig. 1). The verger supplies this pun: When Jonah felt himself in the power of the whale, he was down in the mouth and felt he was going to blubber!

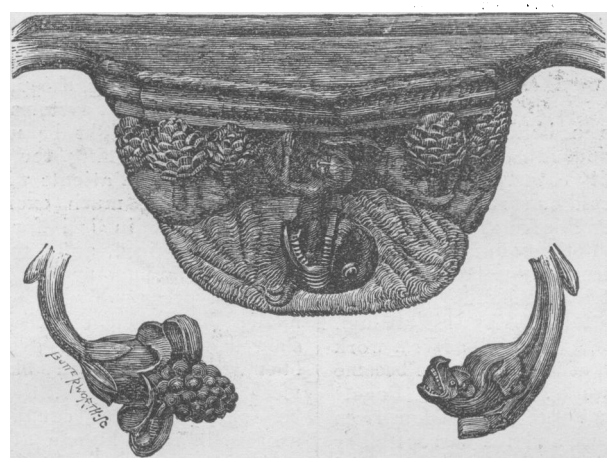

FIG. 1.—Miserere in the stalls of Ripon Cathedral representing Jonah emerging from the mouth of a whale.

The open mouth of a big whale may measure 20 ft. in length, 15 ft. in height, and 9 ft. in width. Such a chamber would easily accommodate twenty Jonahs standing upright.

Many believe that the story of Jonah and the whale stands by itself, but the *Boston Post Boy*, October 14th, 1771, reports upon undoubted authority that an Edgartown whaling vessel, after striking a whale, had one of her boats bitten in two by the whale, and Marshall Jenkins, one of the crew, had been taken into the mouth of the whale, which had then sunk with him. On returning to the surface, the whale had ejected him on to the wreckage of the broken boat, much bruised but not seriously injured. The whale concerned in this exploit must have been a big sperm whale.

In old pictures representing the Jonah Midrash the creature which swallowed the prophet is usually a whale with teeth; but among the beautiful stained glass windows in the famous Groote Kerk of St. John at Gouda there is one in which Jonah is shown fully and immaculately clothed, walking out of the mouth of a huge cod-fish.

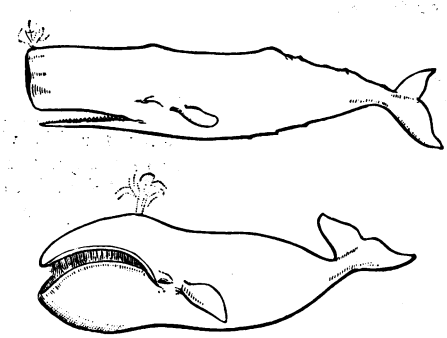

FIG. 2.—Sperm whale and whalebone whale in outline, to show the peculiarities of their heads. (F. Russell Hart.)

Sharks.

Sharks are well described as formidable tyrants of the ocean, and their voracity is almost beyond belief, and sometimes ends in their own destruction.

The diodon, a curious fish not uncommon in tropical seas, is furnished with strong teeth which enable it to break off and crunch branches of coral on which it feeds, and its skin is beset with sharp spines. This fish has the power of inflating itself until it assumes the shape and size of a large ball; when inflated, the spines stand out like the quills of a porcupine; hence the popular name of the diodon is porcupine fish.

Darwin, in 1832, was on the *Beagle* in the South Atlantic when he became acquainted with this curious fish; on the authority of Dr. Allan of Forres, he states that big sharks swallow the porcupine fish, and has frequently found it floating alive and distended in the stomach of a shark. On one occasion a porcupine fish swallowed by a shark had eaten its way out, not only through the coats of the stomach, but through the walls of the body, and thus destroyed its captor. Darwin asks, Who would ever have imagined that a little soft fish could have destroyed the great and savage shark? The diodon inflates itself with air and water, which it expels with some force when it deflates. The jets of water must cause some curious ticklings to a shark with a lively diodon in its stomach!

No one need be sceptical in regard to a shark's ability to swallow a porcupine fish, or of difficulty in accommodating the fish when it reaches the stomach. Some idea of the gastric capacity of a shark may be gathered from the following evidence: Sir William Turner dissected a Greenland shark (*Laemargus borealis*) nearly 12 ft. long. Its voraciousness was revealed by the contents of the stomach: one cod-fish and two salmon averaging 3 ft. in length, nine haddocks, a small skate, the carcass of a small porpoise without its head, and bits of blubber.

A remarkable example of the voracity of the tiger-shark was reported by F. A. Mitchell Hedges. A party of explorers, engaged in deep-sea research in the Caribbean Sea, killed one of these ocean tyrants. This shark measured 17 ft. in length, 9 ft. in circumference, and weighed nearly 2,000 lb.; its stomach contained eighteen deep-sea crawfishes (? king-crabs), each weighing between 4 and 5 lb. Every one had been swallowed whole. It seems a vicious taste on the part of the shark to swallow these extraordinary creatures. They resemble animated coal-scuttles. The fish in this case is called a tiger-shark, not on account of fierceness or rapacity, but for the variegated appearance of its skin.

Lockwood, an American naturalist, studied the habits of king-crabs in 1870. In New Jersey they are used for feeding poultry and hogs; female crabs are preferred. A female king-crab may contain half a pint of eggs; they are like mustard seed, but of an ashy green hue. There is a belief that this diet makes poultry lay, fattens

fowls and hogs, but gives a shocking flavour to the flesh of both.

Things more curious than fishes are sometimes found in the stomach of a shark. In 1779 Michael Fitton, in charge of the tender of H.M.S. *Abergavenny*, cruising off

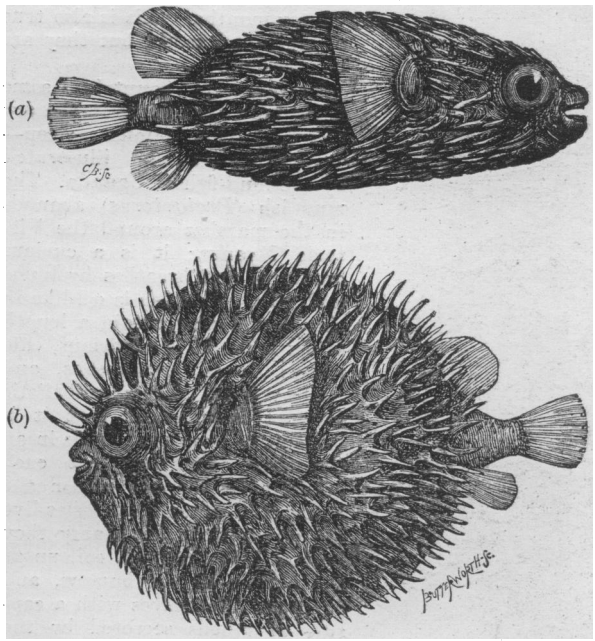

FIG. 3.—Showing porcupine fish (*a*) deflated and (*b*) inflated. When inflated it is as big as a coco-nut. (Gunther.)

St. Domingo, caught a large shark, which was hoisted on board the tender. Some seamen cut the head off the fish and cleaned the jaws, and others opened its maw; it contained "a parcel of papers tied up with string." The letters were of recent date, and Fitton had them dried on deck and read them. One of the letters related to a brig called the *Nancy*, which had been seized as a prize. The captain and the crew of the *Nancy* were tried and convicted with the aid of this letter in the Old Court House, Kingston. How this packet got into such a curious post-box is a matter for conjecture.

Eat and be eaten is the rule among fishes in the sea. Fishes not only eat each other but even their own off-

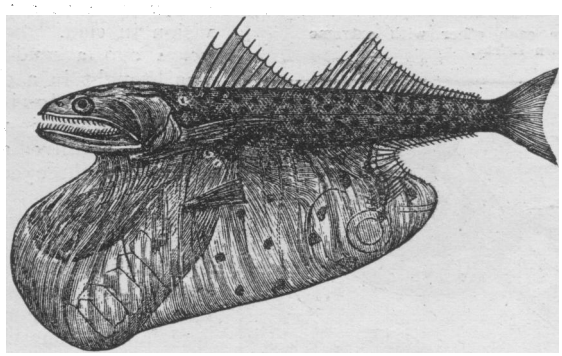

FIG. 4.—The black-swallower (*Chiasmodon nigrum*), a deep-sea fish which swallowed a fish larger than itself. Half natural size. (Natural History Museum.)

spring, and a few are so ravenous that they attack and swallow fishes bigger than themselves. The black-swallower (*Chiasmodon nigrum*) lives at a great depth in the Atlantic Ocean, below 1,000 fathoms. There is an example in the Natural History Museum which was dredged at 1,500 fathoms, and it contains a dead fish bigger than itself (Fig. 4). The captured fish was clearly discernible through the tightly stretched belly when the fish came to hand. The black-swallower is clearly allied to cod-fishes, which are carnivorous, and is sometimes found floating dead on the surface of the ocean with a fish in its stomach. When a fish has been swallowed in such circumstances decomposition outstrips digestion, and the generated gases cause the fish to rise so rapidly from the depths of the ocean that it is killed and floats on the surface. This may be regarded as a good example of *post-mortem* revenge.

An Ocean Crime.

Most of the deep-sea fishes are pale green or blue when caught, but they turn rapidly black. Some are colourless and gelatinous; a few are silvery. In museums they are usually represented by models and these are usually black, but their characters are blacker. The example of the

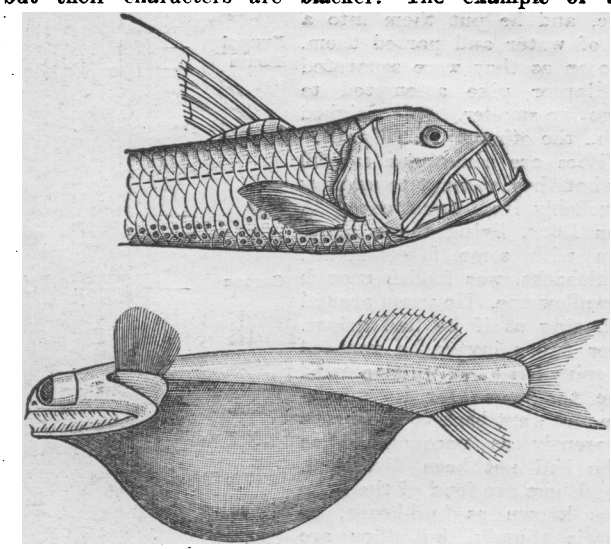

FIG. 5.—*Gigantura vorax*, 80 mm. long, with a Chauliodus 140 mm. long in its stomach (C. T. Regan); and the head of Chauliodus to show its teeth.

black-swallower has been in a measure eclipsed by an exploit of a deep-sea fish, Gigantura (Fig. 5), obtained in the Atlantic by the Dana Expedition (1920-22), and carefully described by Mr. C. Tate Regan. This fish lives at a depth of 500 metres. Its eyes are telescopic, closely packed together, and directed forwards: it has a formidable dental armature—the teeth are slender, sharp, and depressible. In each jaw a pair of anterior canines directed forward are followed by a series of strong, spaced teeth, with smaller teeth between them. The fish is piscivorous, and has a very capacious stomach. It is probably a lurking fish that steals upon its prey, aided by powers of vision beyond the ordinary.

In the "Dana" specimen the fish was 80 mm. long, but neatly packed in its stomach there was a deep-sea fish, Chauliodus, 140 mm. in length. Chauliodus has a formidable dentition, and the Gigantura must have been desperately hungry to attack a fish twice its length and formidably armed with teeth. After an examination of the body of

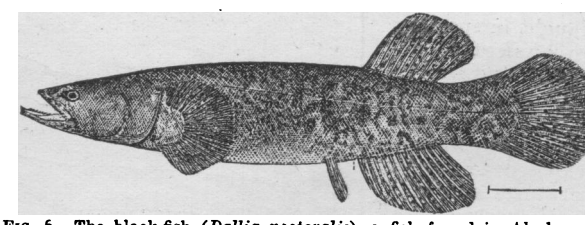

FIG. 6.—The black-fish (*Dallia pectoralis*), a fish found in Alaska; its vitality is astonishing. (Turner.)

the victim, Regan reconstructs the crime in this way: The Chauliodus was seized by the middle, and was swallowed double until it reached the posterior end of the stomach, when its head and tail still protruded from the mouth of its captor. These were then taken in and bent back until the whole fish, now doubly folded, was in the stomach of Gigantura. Digestion affected the part first swallowed, where the flesh has quite disappeared, exposing the vertebral column for a length of 18 mm. It seems horrible to be slowly digested alive!

The pike is the most voracious of freshwater fishes and consumes large quantities of food. Big pike will seize

rats, voles, and it is said they attack foxes and small dogs. They gorge each other occasionally with extreme thoughtlessness for their own safety. In 1880 Dr. Burton supplied Buckland with the following story: A boy saw in the Tweed near Kelso what he thought was a fish with a tail at each end of its body. He caught it and was astonished to find two pike, one of which was trying to gorge the other. They were alive, and he put them into a tub of water and parted them. As soon as they were separated the larger pike attempted to gorge the smaller. One weighed 3½ lb., the other 2½ lb. (Fig. 8).

Fishes are sometimes careful in what they attempt to swallow—probably from experience. A John Dory, living in an aquarium with some fifteen-spined sticklebacks, was foolish enough to swallow one. He swam around squirming as if he had gripes. After two minutes he vomited the spiny little fish, which seemed none the worse for its adventure and went back to the weeds apparently as unconcerned as if he had not been disturbed. Kingfishers are fond of the little fishes known as bull-heads, or miller's thumbs, but they are cautious in selecting their prey, for the big pectoral fins of these fishes may stick in their gullets. This is another form of retaliation. In musing on such events I think most will agree with Shakespeare:

> "The sense of death is most in apprehension,
> And the poor beetle that we tread upon,
> In corporal sufferance feels a pang,
> As great as when a giant dies."

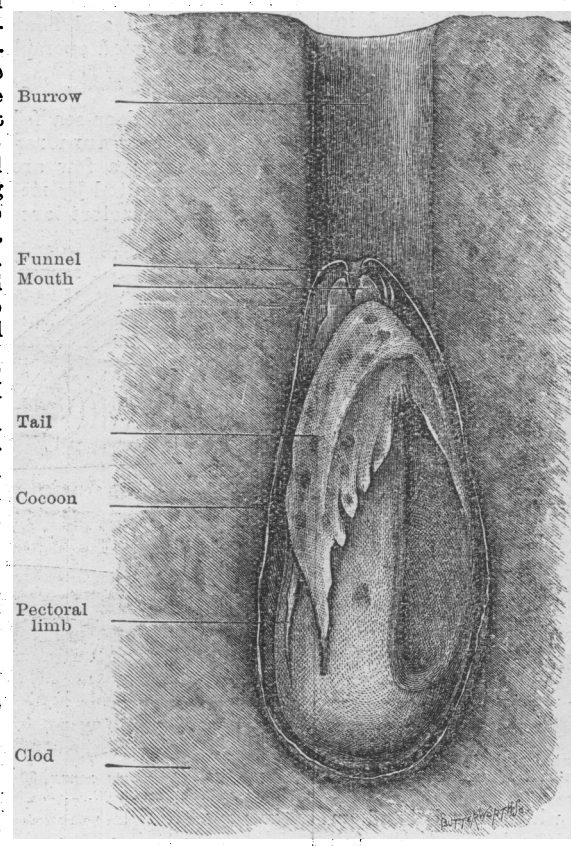

FIG. 7.—Mud-fish, torpid in its clod. (Newton Parker.)

A live fish in an animal's stomach must cause some discomfort. The black-fish (*Dallia pectoralis*, Fig. 6), discovered by L. M. Turner, lives in the sphagnum ponds and swamps of Alaska. These fishes exist in enormous numbers, and are the chief food of the natives; they are caught in specially made baskets. Between May and December many tons of these fishes are taken to the villages; as they are exposed to severe temperatures and cold winds, the mass of fish in each basket is frozen in a few minutes. When required they are chopped out with an axe. The vitality of these fishes is astonishing. They will remain in the grass baskets for weeks, and when brought into the house and thawed out they are quite lively. Dogs swallow them eagerly. The heat of the dog's stomach thaws the fish, and the movements of the revived fish soon cause the dog to vomit it alive. The fish seems to be a long-suffering creature. What of the dog? We may say of our friend—he got rid of an ill considered meal in a sagacious manner. Several varieties of our fresh-water fishes bury themselves and lie torpid in mud during the winter months. This is also true of frogs and toads, but they are not frozen.

In tropical countries some fishes bury themselves in the dry season. This summer sleep—aestivation—is well illustrated by the mud-fish of Uganda. The mud-fish (*Protopterus*) abounds in the marshes around the Victoria Nyanza; it is a curious creature, and breathes by lungs and gills. This fish is eel-like in shape, and may attain a length of six feet. It is rapacious, eats worms, frogs, crustaceans, and its own kind. The cannibalistic instinct is so great that it is difficult to keep mud-fishes in an aquarium, for they eat each other. In the hot season the marshes in which these fishes live dry up; to meet this change they burrow into the mud, coil up at the bottom of the burrow, and surround themselves with a capsule of mucus secreted by the skin glands (Fig. 7). Sequestered in this way the fishes breathe entirely by their lungs half the year, and remain secluded in the marshes until the return of the rain. When a mud-fish adjusts itself to the cocoon, the flask-like cavity which contains it is closed by a perforated lid; the margin of the hole forms a funnel which leads to the lips of the fish. If a straw be gently passed down the funnel it will, if alive, utter a cry. The fish is so completely encapsuled that it may be dug up and transported anywhere. The Baganda eat the mud-fish; some natives regard it as a delicacy, and keep it as a provision in clod. Some years ago a mud-fish was brought in a clod to the Zoological Gardens, where it was released, and lived and thrived for three years.

FIG. 8.—Pike occasionally attempt to gorge each other with extreme thoughtlessness for their own safety.

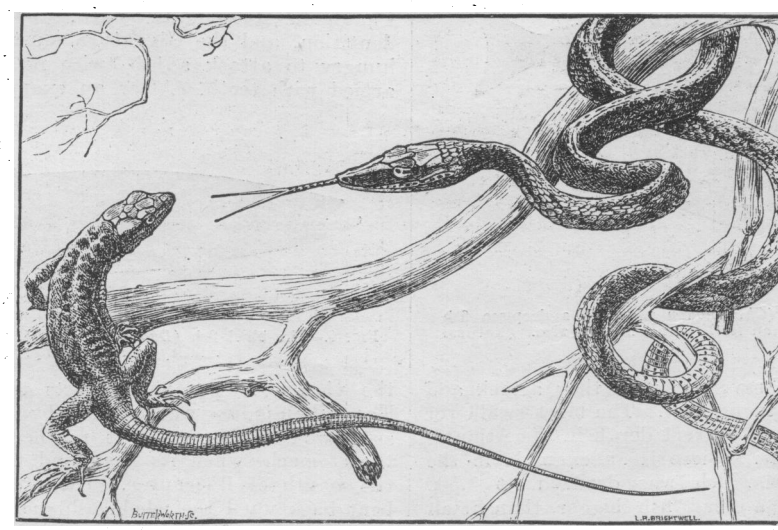

FIG. 9.—Silvery tree-snake fascinating a lizard.

Snakes and Frogs.

As a rule people dislike snakes, but some snakes are harmless, can be easily tamed, and allow themselves to be handled. Some snakes become affectionate in captivity, but most are morose. Even a cobra may become a pet, as in the case of the albino cobra caught by Mr. J. C. Roberts of Delhi. Albino snakes are rare, and in this instance Mr. Roberts is very attached to this cobra, carrying it about everywhere with him and allowing it to caress him. The dislike to snakes may be in part due to the influence the

serpent exercised over Eve. The serpent in this instance must have been a tree-snake, because in Milton's description it climbed the apple-tree. It was a snake that

> "Led Eve, our credulous mother, to the Tree
> Of prohibition, root of all our woe."

Snakes, especially cobras, are prominent in the Hindu Pantheon. There are many snake tales in Hindu religious writings, and Lamia stories in which a prince accidentally swallows a snake which lives on his vitals.

It is impossible to comprehend reptilian psychology; Joan Procter has described a curious instance of a silvery tree-snake fascinating a lizard (Fig. 9). The tongue of this snake is coloured in the same style as its head; when the tongue is protruded through the rostral nick, with the lips closed, it appears to be a continuation of the snake's snout. She has seen a lizard watching the hovering tongue in perplexity, quite engrossed, and the snake striking at close range without startling the usually swift and cautious prey. Miss Procter describes the effect of this "pulling faces" as really most arresting to witness.

It is easy to prove that the prey of constricting snakes are frequently swallowed alive and survive delivery by human agency.

Rudyard Kipling supplied me with the following incident. At Bateman's, in the county of Sussex, the gardener found a grass-snake with a bulge in the belly, and promptly lopped off the snake's head, slit open its belly, and with a little help "a frog slid out head first, but alive." Rana was plentifully lubricated with saliva, and on the rump there were marks of two fangs. Otherwise no damage. The frog emitted a low croak as it was returned to a proper home among the lilies in the pond.

John Roscoe, missionary and ethnologist, while travelling from Uganda to Gondokoro, came across a snake engaged in swallowing a big frog. It was curious to watch the frog struggling to make its way down the snake's gullet, evidently thinking this the way of escape A native killed the snake. Roscoe opened it and released the frog, which sat blinking as though astonished to see the light again, and then jumped among the grass.

FIG. 10.—Tree-frog (*Hyla blandsuttoni*, Procter); showing pads on the tips of the fingers and toes. The first finger, slightly longer than the second, is used as a thumb in life.

Tree-frogs are favourite food of snakes. They have pads on the ends of their fingers and toes. The skin covering the pads contains glands which secrete an adhesive fluid which enables the frog to stick on a slippery surface such as a leaf; they adhere as much by the belly as by their digits. Tree-frogs can jump; when the artist was engaged sketching the frog (Fig. 10) he suddenly missed it and began hunting around. In despair he sat down and looked at the drawing. Suddenly he was astonished to hear "Eep, eep, eep," close to his ear, and felt something cold on his neck. To his astonishment the frog was sitting on his shoulder croaking agreeably and—criticizing the drawing!

Gadow, whose interest in amphibia and reptiles leads him to keep, and tame, frogs and snakes, considers the grass-frog "a jolly and intelligent fellow."

We know little, and can only surmise in relation to ranine psychology, but I have heard of a psychologist who made an excellent use of a frog in the following circumstances.

A thin and foolish woman believed she had accidentally swallowed a frog and that her thinness was due to the frog eating the food in her stomach. In order to dispel the illusion the doctor gave the patient an emetic and during the vomiting he slipped a small frog into the basin. When the patient saw the frog her joy was great, but in a few minutes her depression returned: "Oh!" she exclaimed, "I am sure this frog has left some young ones in my stomach." The doctor looked wise, pulled out his magnifying glass, and after critically examining the frog said unto the patient, "Fear not; this frog has not left any froglets inside you. Behold, it is a male!" The patient was quite satisfied, became happy, and in a few months was plump again. She was not a naturalist, and therefore ignorant of the fact that it is difficult to tell the sex of frogs by mere inspection except at the breeding season.

Mary Kingsley knew a witch doctor at Kacongo, West Africa, who treated bewitched persons, and was successful in removing the witch with rubbings and an emetic. In the vomit he always found several lively young crocodiles. Magic and mystery worthy of a conjurer!

Snake-swallowing Snake.

Deglutition in snakes is a remarkable process. These reptiles are carnivorous and, as a rule, take living prey. Many swallow the victim alive, some kill by constriction; poisonous snakes kill small mammals, birds, and fishes almost instantaneously, and swallow the prey at leisure. The progress of deglutition is often slow and laborious, and can be watched in a menagerie. A python twenty feet long can swallow a goat or a pig. In some countries (Congo Territory) when the natives find a python gorged with a pig, they kill the python, release the pig, and then eat both the python and the pig.

In reptile houses the fondness of snakes for frogs is cleverly utilized. The king-cobra eats snakes and disdains frogs. In England it is difficult to obtain grass snakes in winter: the keeper gives the grass snake a frog and then passes the frog-containing snake to the king-cobra, who thus gets the captive frog as well as the snake. Even snakes can be tricked.

Cannibalism signifies the eating of human flesh by human beings; the term "cannibal" is often applied to animals which eat their own species. It is true that snake swallows snake sometimes accidentally, sometimes intentionally. It occasionally happens in menageries that two snakes fasten on the prey, and as neither is willing to let go its hold the stronger will engulf the prey and the snake which clings to it. Thus, in the well known case reported by Bartlett, a big boa eleven feet in length fastened on a pigeon; a companion boa nine feet in length also fastened on the pigeon. In the course of a night the larger boa swallowed the pigeon and the boa, and, what is more remarkable, it not only digested them but survived, and twenty-eight days later took a pigeon. This was clearly an example of unintentional snake-cannibalism.

The king-snakes (Ophibolus), common in the United States, Mexico, and Central America, are recognized cannibals. These pretty constricting snakes may attain a length of six feet; they are mild and inoffensive to man, allow themselves to be handled, and learn to recognize their keepers, and feed from their hands.

The king-snake is named from the fact that it is immune to snake poison; this reptile eats birds, lizards, and small mammals, but prefers snakes, and even poisonous snakes. It is said that king-snakes will eat eels, probably mistaking them for snakes. They eat their own species. When animals are given them for food they get excited, and when several king-snakes live in the same compartment they are apt to attack and swallow each other. The liability to such accidents is well known, so that when king-snakes, living in company, are supplied with frogs and mice, the keeper looks after them, because, if two snakes seize on the same prey,

the stronger snake may, and probably will, engulf his opponent as well as the rat. It has happened that when a boa has engulfed a companion, the keepers have succeeded in withdrawing it by steady traction on their tails. Snakes have not only recovered after such an occurrence, but lived together in amity.

Snake-swallowing by snakes was well known to the ancient Egyptians. When Moses and Aaron met the magicians in Pharaoh's court they knew the trick of making serpents become stiff rods, and when cast upon the ground Aaron's rod swallowed up the Egyptians' rods (Exod. vii, 12).

Meditations on the psychology of the swallowed suggest that the animal world may be divided into swallowers and the swallowed. A whale swallowed Jonah, but it is wiser for a man to swallow a whale than to swallow a lie!

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DIFFICULTIES IN THE DIAGNOSIS OF LEUKAEMIA.

BY

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THE nomenclature of the leukaemias is still in a fluid state, and the subject has been discussed elsewhere (Gulland and Goodall, *The Blood*, third edition, 1925, p. 212). It seems desirable to keep the terminology as simple and yet as precise as possible, so we have adopted the terms "non-granular" and "granular" as the main subdivisions—the former including two acute forms, the myeloblastic and lymphatic, and the chronic lymphatic form, the latter the acute and chronic forms of myelocythaemia.

The acute myeloblastic and lymphatic forms are probably the most common, but many of them are certainly not diagnosed, and in any case their duration is short. The chronic forms last for years, are practically always recognized sooner or later, and bulk therefore more largely in the mind of the practitioner. I shall accordingly deal first with them.

CHRONIC GRANULAR LEUKAEMIA.

In the chronic granular leukaemias the disease is so insidious in onset that the first thing to attract attention, if the patient comes under observation before the anaemia is marked, is usually the enlarged spleen. It is surprising how often there seems to be difficulty in determining whether it is the spleen which is enlarged or some neighbouring organ. I remember a febrile leukaemia in a woman, many years ago, which was sent into a surgical ward as a cellulitis of the abdominal wall. The surgeon was clear that this was a wrong diagnosis, but thought the spleen was a tumour of one of the pelvic organs, and transferred the case to a gynaecologist, who was certain that the tumour was not pelvic, but refused to determine its nature. Of course a blood examination settled the matter. Enlarged spleens in leukaemia may and do wander all over the abdomen, and might be taken for any organ in turn, according to their temporary position. Comparatively small enlargements are often taken for tumours of the splenic flexure, and several times patients have come to me who had been *x* rayed after barium meals and enemas. The true nature of the mass was only suspected when the passage was found normal. It often takes much more than a momentary examination to settle whether a given enlargement is spleen or kidney. Neither organ, when enlarged, invariably retains its typical shape; the kidney may become very superficial, and the colon which crosses it may be loaded, or empty and spastically contracted, and not easily made out, and there are many cases of kidney swellings with blocked ureters in which the urine gives no help. Some cases have required air enemata, ureteral catheterization, full blood examination, etc., before their nature was definitely determined.

To-day I saw a man whose right kidney was removed some years ago for calculi associated with constant pain and haemorrhage and the formation of a large tumour. At operation the kidney was found to be cystic in addition, and it was suspected that the left kidney was in the same state. It has steadily enlarged and the diagnosis is undoubtedly correct. Since my last examination the kidney had increased considerably in size, and so altered in shape that it looked at first as if a splenic enlargement was superadded to that of the kidney. The converse of this case was supplied some time ago by a very anaemic woman with great digestive disturbance, who came to me with the diagnosis of cancer of the stomach. Her left kidney had been removed for pyonephrosis many years before, and the spleen, which was only moderately enlarged, did not come forward as usual, but, in the recumbent position, lay well back in the left flank and under the ribs, and had to be looked for. She had advanced granular leukaemia.

The blood in these cases when they first come under observation is almost invariably so typical that no error is possible if the attendant examines it or causes it to be examined. The initial count, however, even with a markedly enlarged spleen, may vary greatly—from 500,000 or more to 42,000, 35,000, and 22,000, which are the lowest I have seen. The blood in these cases with low counts was nevertheless quite typical. The only likelihood of error is the presence of a febrile complication, which sometimes causes a drop in the white count to normal or subnormal figures, or the rare possibility of a spontaneous remission. But even then abnormal cells will almost always be present which will give the necessary indication, though they are sometimes few in number.

The effect of radiation on the blood is by no means uniform and is difficult to forecast. The rule, of course, is a marked diminution in total numbers with a special drop in the immature granular cells, but there may be no effect at all. Generally speaking, this refractory state is more common in cases that have previously been irradiated, but it does occur in cases treated thus for the first time as soon as the disease was diagnosed; and, on the other hand, some cases will respond repeatedly to radiation until the course is cut short by some complication. It is important to remember that the effect of radiation persists for months sometimes, and that there may be a progressive diminution in the number of the leucocytes. For this reason one usually stops radiation when the white count has reached 20,000, as there will probably be a further drop when treatment has ceased. The case mentioned above with an initial count of 22,000 was treated by *x* rays to the long bones for special reasons. This was stopped when the count fell to 12,000 three months ago, and the count is now about 5,000 with practically normal proportions. In the last films no immature cells of any kind could be found; the usual excess of basophils had disappeared, and the film looked like an ordinary mild secondary anaemia with a slight leucopenia. After prolonged search one normoblast was found. If this film had been examined by someone unacquainted with the history of the case, diagnosis would have been impossible.

Radiation may apparently, however, sometimes produce